Multiple bimanual motor deficits in elderly predicted by diffusion tensor imaging metrics of corpus callosum subregions

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Objectives

Age-related changes in the microstructural organization of the corpus callosum (CC) may explain declines in bimanual motor performance associated with normal aging. The goal of this study was to investigate the pattern of relationships between structural properties of functionally distinct subregions of the CC and age-related performance deficits on different bimanual motor tasks.

Methods

We used diffusion tensor imaging (DTI) in young (n=33) and older (n=33) adults to investigate the microstructural organization of 7 specific CC subregions (prefrontal, premotor, primary motor, primary sensory, parietal, temporal and occipital), enabling a comprehensive view on location of age-related differences in CC microstructural properties. A set of bimanual tasks, emphasizing partly different sensorimotor processes and likely to yield age effects, was used to assess bimanual motor functioning: the Purdue Pegboard test, assessing fine finger manipulation speed; the finger tapping task, assessing simultaneous and alternating finger tapping speed; a choice reaction time task, assessing bimanual reaction speed; and a complex visuomotor task, assessing bimanual coordination accuracy. We investigated group differences in DTI metrics and in bimanual motor behavior. Ultimately, we explored the relations between the fractional anisotropy (FA) values of the 7 CC subregions, as a measure of white matter microstructure, and the different bimanual motor scores.

Results

DTI results revealed a reduction of FA values in the CC prefrontal region and an increase in FA values in the CC primary motor region in older compared to younger adults. Behavioral results revealed that the older adults performed worse on all measures of bimanual motor performance as compared to the younger adults. Within the older adults group, FA of the CC occipital region was associated with bimanual fine manipulation skills (Purdue Pegboard test), whereas better performance on the other bimanual tasks was related to higher FA in the more anterior premotor, primary motor and primary sensory CC subregions. Such associations were less prominent in the younger group and no overlap in correlations was found with the older group.

Conclusion

Our findings suggest that structural alterations of subregional callosal fibers may account for bimanual motor declines in normal aging.